§10. Construction of 6 MeV Heavy Ion Beam Probe for LHD

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As for 6 MeV HIBP, FY. 1996 is devoted for design, construction and testing of 1) a computer controlled negative gold ion source, 2) a large sector magnet to prevent the acceleration of light nucleus, 3) overall design work of the beam accelerationt

The negative ion gold source to be used at a tandem accelerator with the terminal voltage of 3 MeV, is a plasma-sputter ion source, developed by Y. Mori et al. of KEK and by M. Sasao et al., in NIFS. After a half year of work on computer control of the ion source operation, we got a constant maximum negative gold current of about 6 micro amperes in our ion source measured by a Faraday cup with permanent magnets prepared by M. Sasao. In order to have a small phase space of the beam the gold target in the source is reduced to the diameter of 13 mm. A few times larger currents may be needed for LHD HIBP, and it may be expected by small modifications. Major problem may be the short life limited by the consumption of cesium. The computer control of several power supplies of the ion source is performed by the system developed by Hidekuma et al., through Windows NT-VME-GPIB. Vacuum system control by Windows NT-VME-RS232C-PLC(programmable logic controller) will be performed in 1997. Fig. 1 shows our design of the control system.

The acceleration of only heavy ion beam is very crucial for the safety problem. The electrostatic tandem accelerator with the terminal voltage of 3 MeV is located in the building with thick concrete wall up to 60 cm contains to reduce the x-ray. A light nucleus accelerated to 6 MeV can generate neutron in addition to the x-ray. In order not to accelerate the light nucleus, the comparative study between sector magnet and E/B selector was performed. E/B selector has advantage allowing alignment of various components by a helium neon laser. Since the E/B selector may allow the penetration of the low energy electrons as long as the velocity is the same with that of the heavy ion beam, a robust sector magnet is constructed. In addition, E/B selector is complicated in order to generate a very homogeneous intense electric field at the very narrow gap of the mouth of the magnet The low-energy part of the accelerator is modified to avoid the cooling system to be placed in 100 kV station as shown in Fog. 1. The pre-acceleration of the ion beam to the accelerator is 100 kV.

The 3-staged electrostatic quadrupoles are placed after the ion source to adjust the defocusing power of the low-energy intense beam from the ion source and the large focusing power of the preacceleration to 100 keV.

Reference

1) Y. Mori et al., R. S. I, **63** (1992) 2361.

Figure 1. The schematics of the low energy part of the tandem accelerator